Modulation of metallic oxide particle behaviour in a formulation: physicochemical and/or sensory properties of emulsions as a tool to identify particles interactions within the matrix

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Modulation of metal oxide particle behavior in a formulation:

physicochemical and sensory properties of emulsion as a tool to identify particles interaction within the matrix

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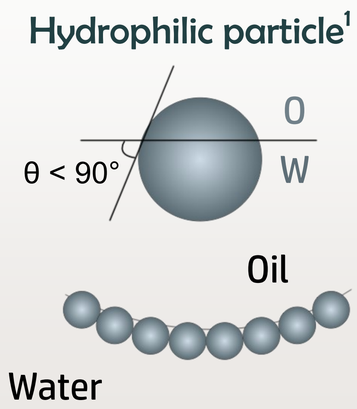
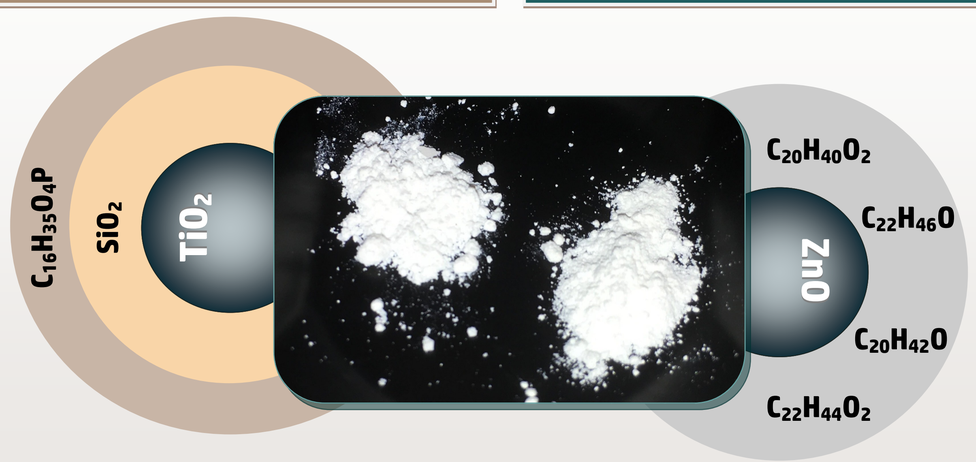
The aim of this study lays on the fundamental approach in the understanding of the behavior of the systems containing solid particles

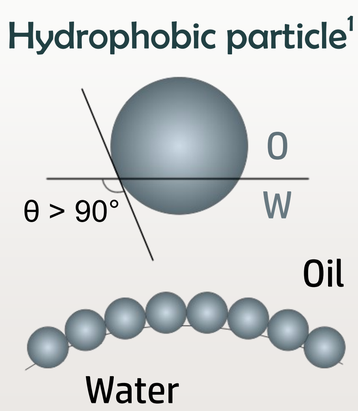
Two metallic oxides were selected depending on their different physicochemical properties and introduced in a formulation. Then, *stable, homogeneous and totally emulsified* systems, never discussed in the literature before, were described through a fundamental, multiscale characterization. Rheological, thermal and sensory behavior, as well as emulsion colloid size and size distribution, were used as a tool to identify the role of the particles on the matrix organization.

Titanium Dioxide, Silica, Cetyl Phosphate

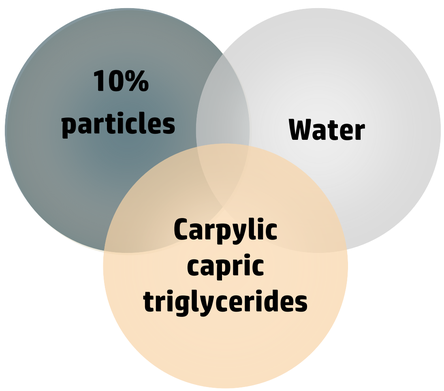




Zinc Oxide, Jojoba Esters

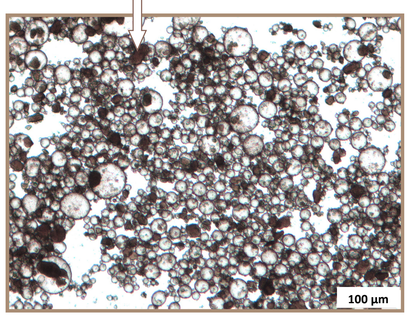


Emulsification



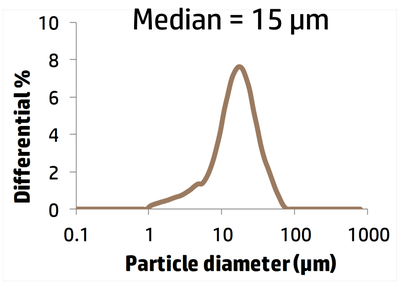
EM_TiO_2 O/W

Particles agglomeration



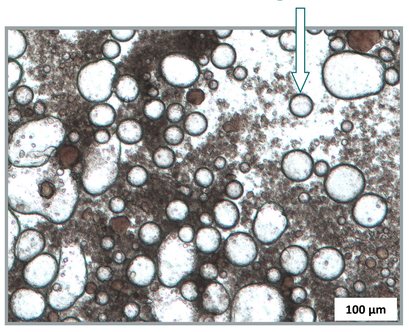
O/W spherical droplets

Volume distribution



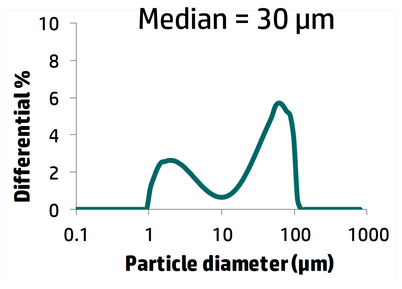
EM_ZnO W/O

Particles covering the water droplets



W/O spherical droplets and distorted droplets

Volume distribution



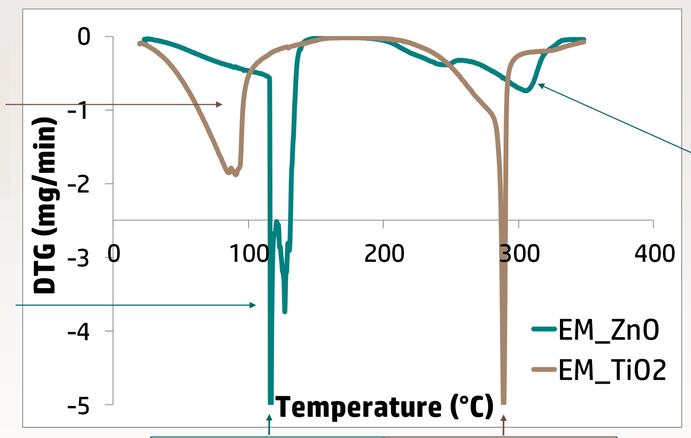
Microscopic scale

- Particles promoted the emulsion formation through the stabilization of the oil/water droplets inside the matrix
- Droplets visual aspect is influenced by the particle type

Thermogravimetric analysis

O/W TiO_2 emulsion water free evaporation (continuous phase)

W/O ZnO emulsion water retained as internal phase



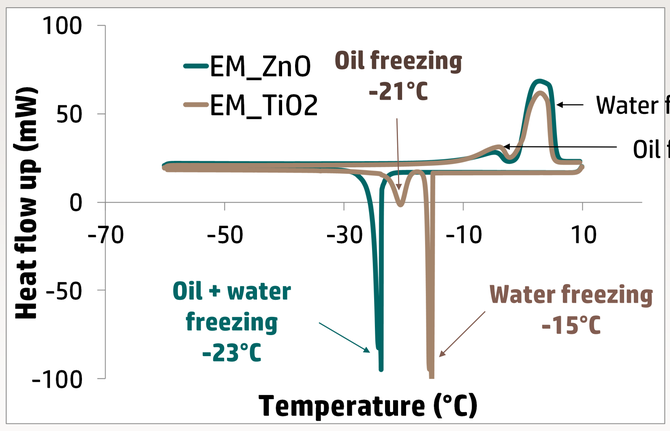
Droplet destruction = water evaporation

Droplet destruction = oil instant release

Thermal response

W/O ZnO emulsion oil free release

Differential scanning calorimetry



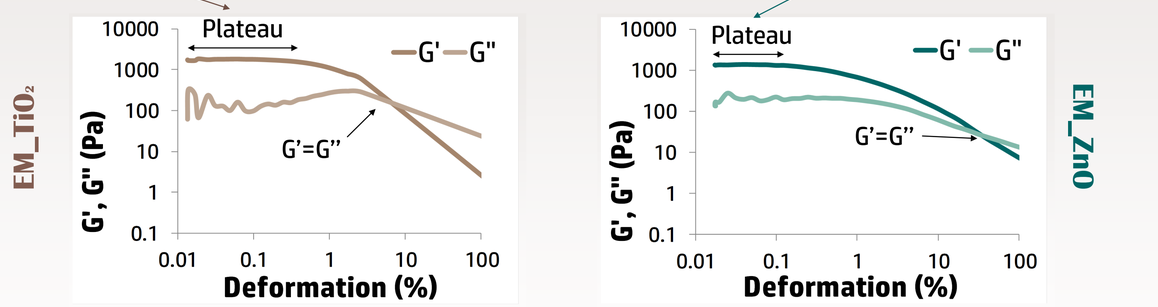
W/O ZnO emulsion: Internal water phase inaccessible = common water/oil freezing peak

Macroscopic scale

Oscillatory rheology

Resistance to the deformation

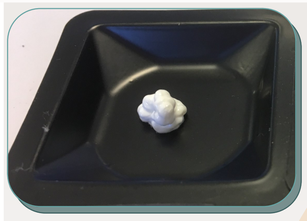
Short G' plateau - immediate response of the product to the increasing deformation

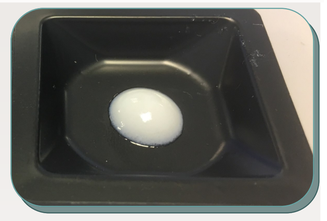


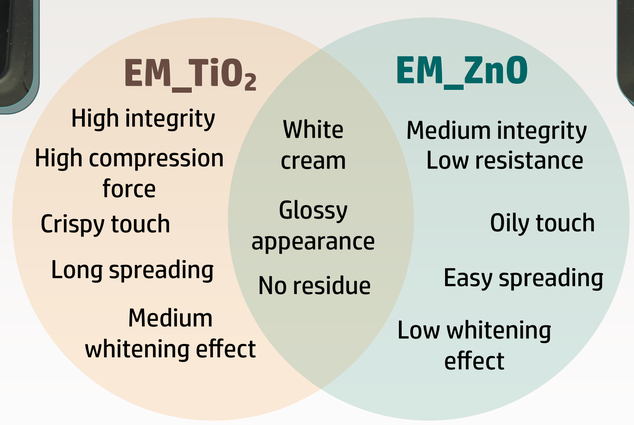
Rapid emulsions destruction

Flexible structure

Sensory perception







Conclusion

This study showed that emulsions stabilized with solid particles :

- Can be of oil on water or water in oil type, depending on the particle properties (hydrophilic or lipophilic);
- Possess specific thermal behavior, due to the particle strong adhesion on the droplet surface;
- Show individual macroscopic response and sensory perception, governed not only by the emulsion type, but also by the particles individual properties.

The chosen particle type clearly impacted the properties of the system at microscopic and macroscopic level. This impact should be taken into account when discussing classical emulsions containing particles in their composition. The next step of this work will be to complete the studied range of particles with other metal oxides to achieve the fundamental understanding of the particles role in the matrix.

[1] Binks, B. P. Particles as surfactants—similarities and differences. *Current Opinion in Colloid & Interface Science* **7**, 21–41 (2002).

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